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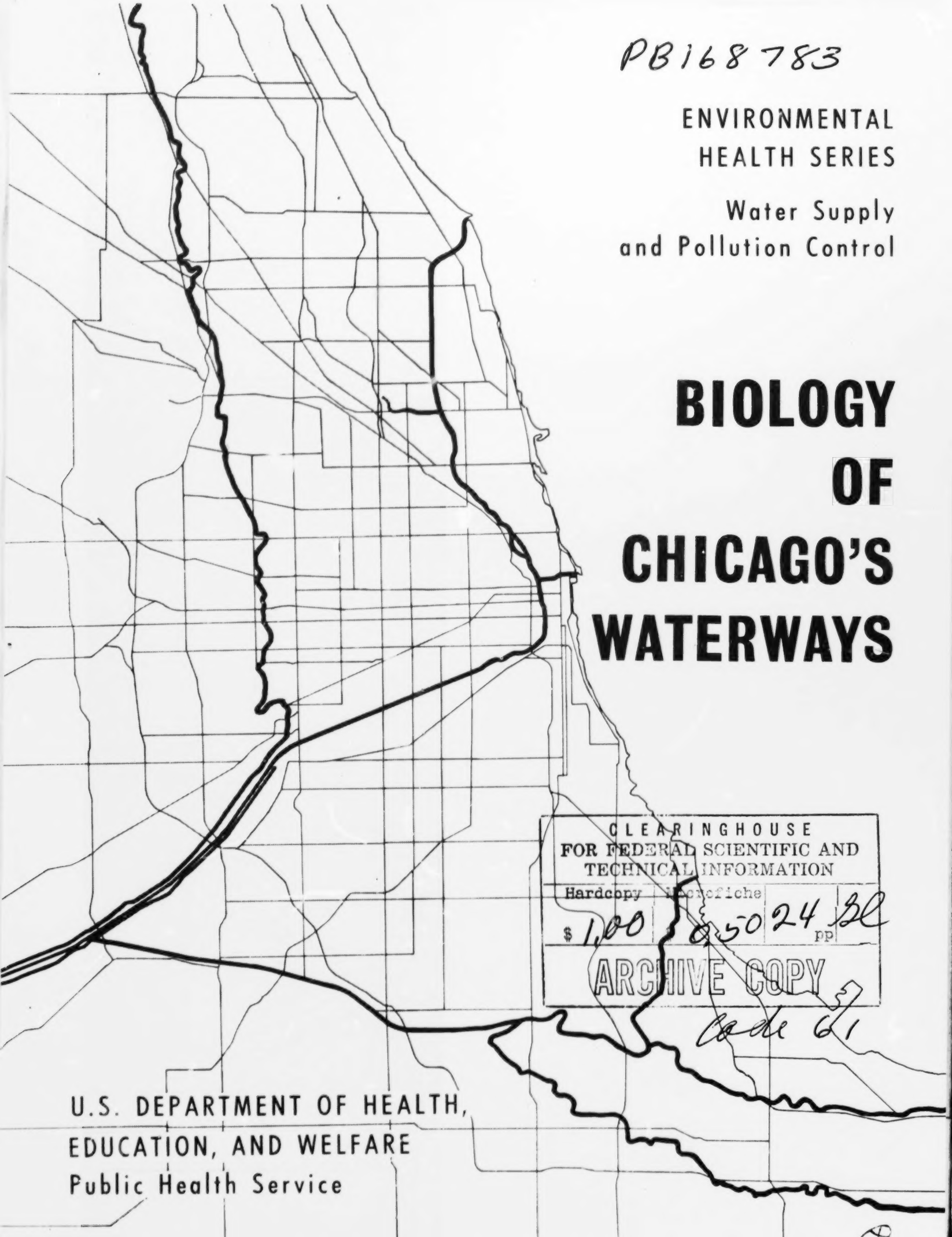
BIOLOGY OF CHICAGO'S WATERWAYS



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BIOLOGY OF CHICAGO'S WATERWAYS

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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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Division of Water Supply and Pollution Control

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BIOLOGY OF CHICAGO'S WATERWAYS

INTRODUCTION

The bulk of the biological data reported here are based on the sampling of bottom organisms and phytoplankton between April 19 and May 11, 1961. Some general information on fish, that were gathered from casual observations, are included.

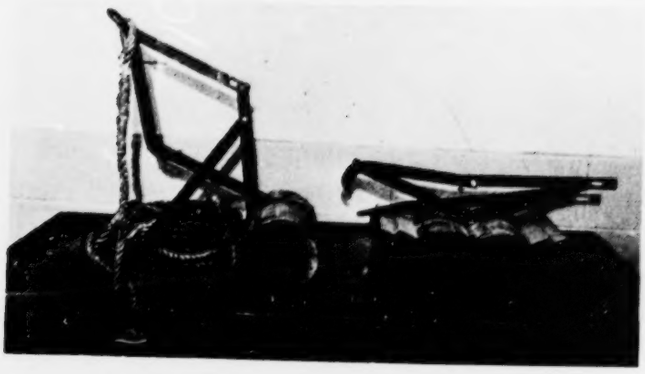
Bottom organism samples were collected with the Ekman dredge (Fig. 1B) with some supplemental exploratory sampling done with the Petersen dredge (Fig. 1A). Phytoplankton samples were analyzed from unconcentrated water samples that were taken from the bacteriological sample bottles. For an immediate visual determination of the gross bulk of phytoplankton that were present ten liters were concentrated through a standard (Number 12) plankton net. (Fig. 2).

The bottom organism biological data especially indicate that all areas of the Illinois Waterway that were studied in Cook County were degraded. Even the stations with the greatest variety of types of bottom organisms collected in Cook County show indications of pollution (i.e., immediately below the Wilmette lockage, Mile NS340.7, and immediately below the Chicago Harbor lockages, Miles CH326.9 and CH325.8). Cleaner water associations of bottom organisms were represented only on the Des Plaines, Mile DP292.7, and the Kankakee Rivers, Mile KR277.5. (Figs. 3 and 4).

Dredge sampling indicated that the bottom life typically consists of organisms that are associated with organic domestic-sewage type sludges. The sludges from which bottom organisms were taken commonly revealed garbage particulate matter and sewage in various stages of decomposition accompanied by fecal odors, often masked with petroleum odors and often mixed with oily materials. (Fig. 5)

The dominant bottom organisms at all stations sampled, in Cook County, were sludge worms, that reached tremendous populations. (Fig. 6). These same worms are often associated with sludge-drying beds at sewage treatment plants, and are obvious in small creeks throughout the country where sludge from domestic sewage pollution accumulates on stream bottoms. In shallow streams which afford visual advantages of the observation of the bottom, not afforded in the canalized reaches of the Illinois Waterway that were sampled, populations of them can be seen as red patches living in decomposing domestic-sewage sludges. Here they burrow into the upper surfaces of sewage sludge as they feed, leaving their rear ends extending into the water. Such red-colored, wormy blankets form a signal to the investigator that the stream is being defiled with organic wastes that may be issuing from a domestic sewage source, or sources, or from an industrial outfall rich in decomposable, putrefactive organics as discharged from a slaughter house, cannery, beet sugar refinery, etc. On occasion these red sludge worms are found in natural lakes and streams that are not subject to man-made pollution; here they do well on natural organics such as may be formed from dead and decaying aquatic weed and algal mats interlaced with leaves that have been washed into the water, or they may be found blanketing the putrefying carcass of a dead beaver, muskrat, fish or water fowl.

A



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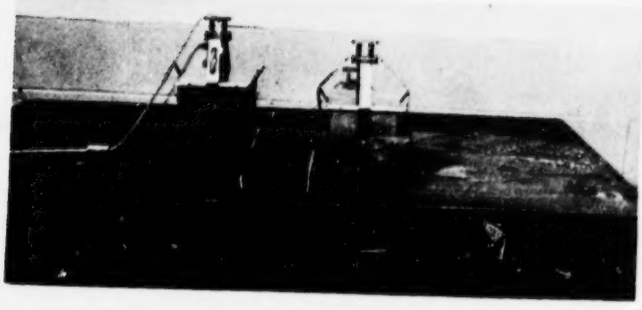

FIGURE 1. Sampling Equipment Utilized for Quantitative Macrobenthic Organism Sampling. a) The Petersen Dredge, b) The Ekman Dredge.

FIGURE 2. Plankton Net Utilized For Gross Visual Bulk Determinations of Phytoplankton Quantity.

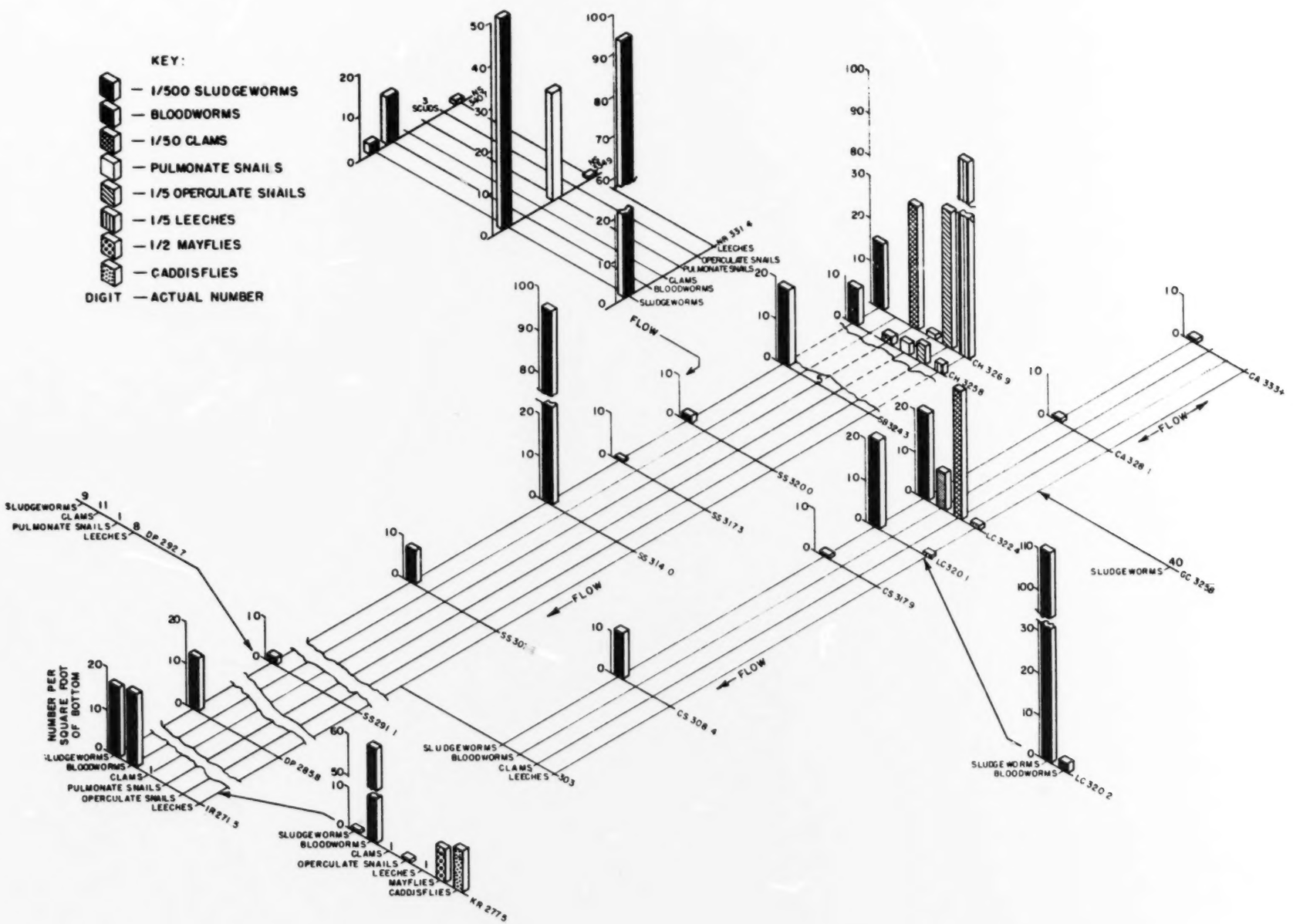

FIGURE 3. An Isometric Projection Showing the Mean Number and Variety of Organisms at the Stations Sampled in the Upper Illinois Waterway.

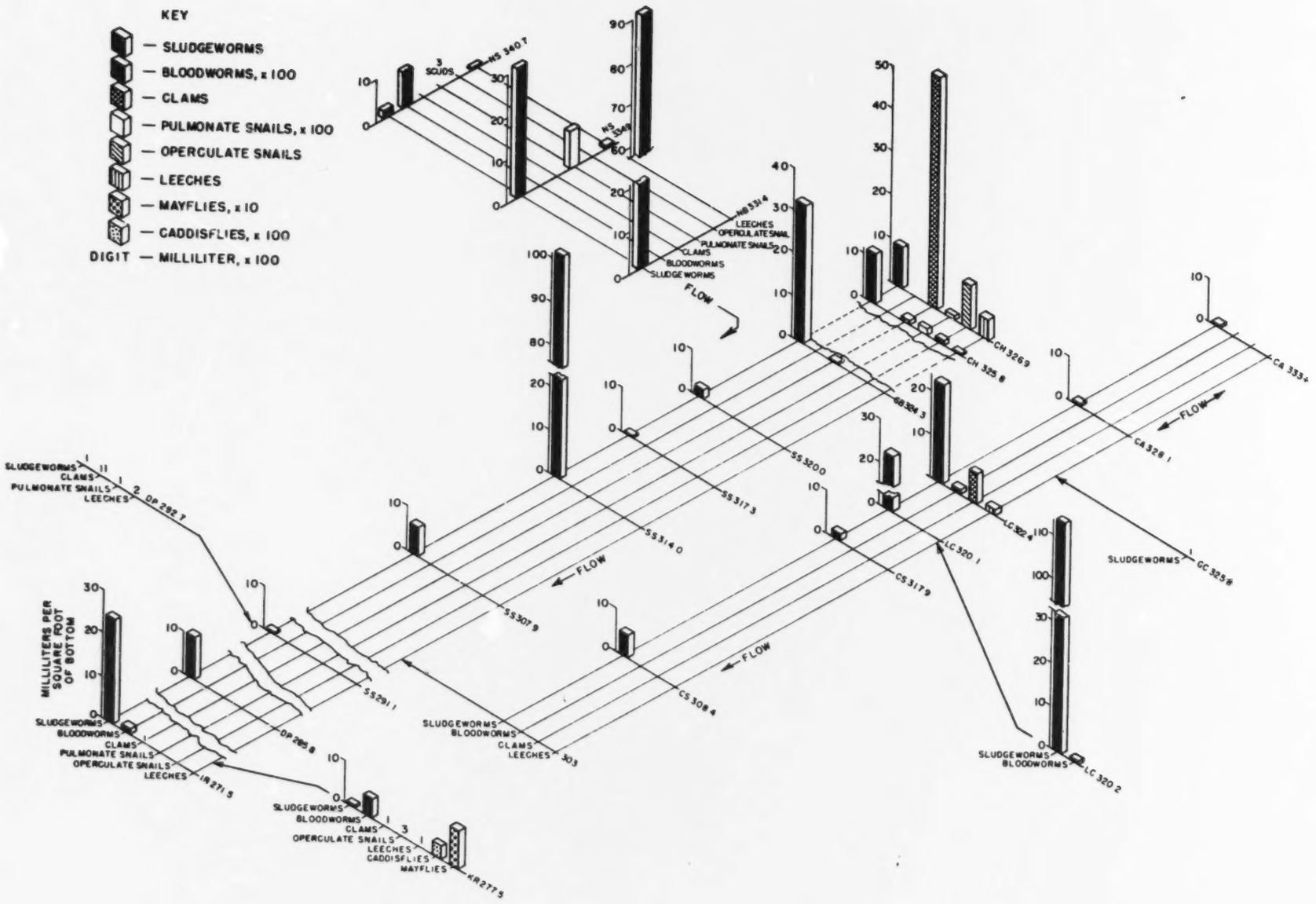

FIGURE 4. An Isometric Projection Showing the Mean Volume and Variety of Organisms at the Stations Sampled in the Upper Illinois Waterway.

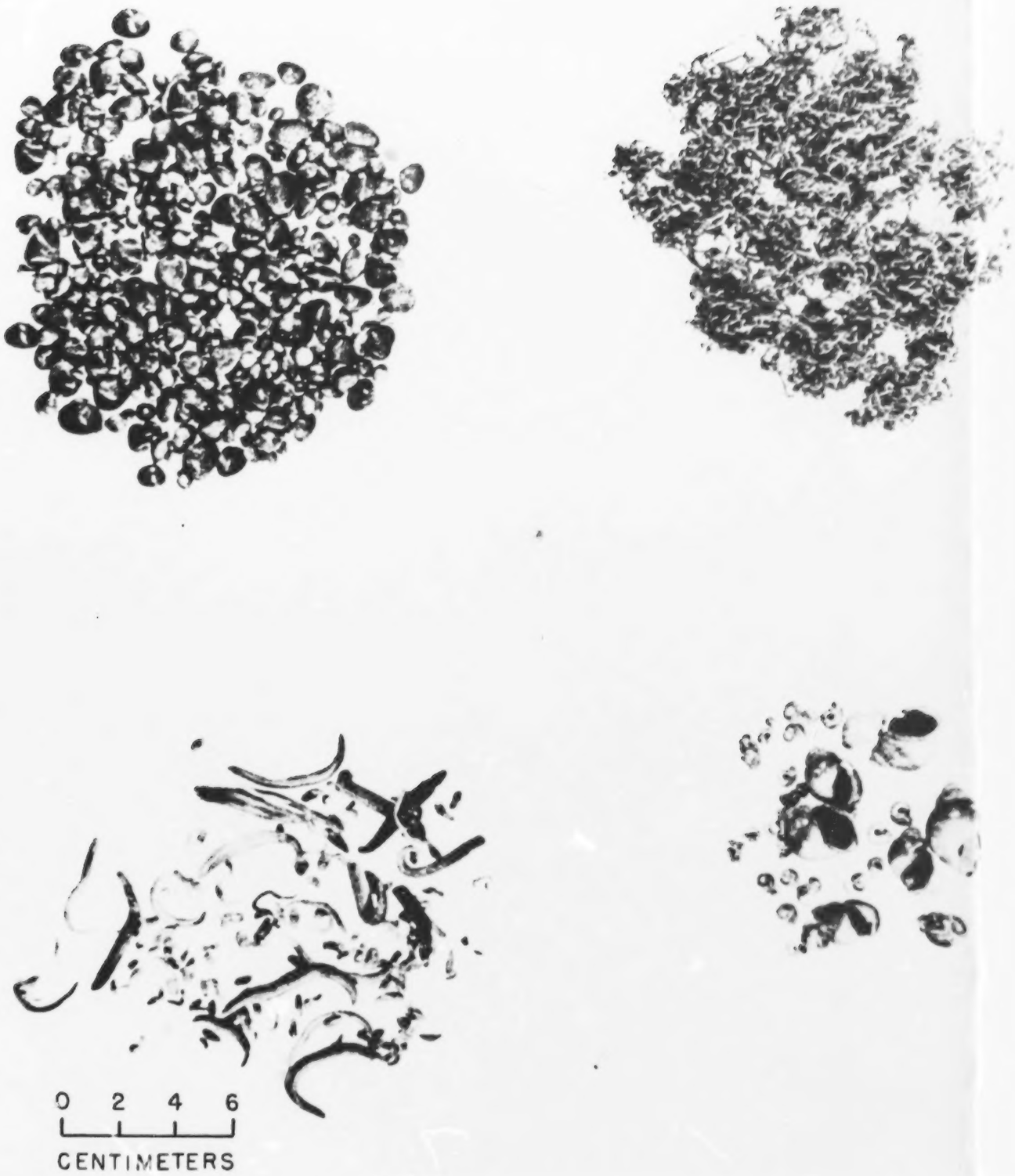

FIGURE 5. A Photograph Showing the Diversity and Quantity (per 1/4 square foot of bottom surface) of Various Kinds of Organisms at Station CH326.9. A Similar Sample Taken From Station SS314.0 is Shown in Figure 6.

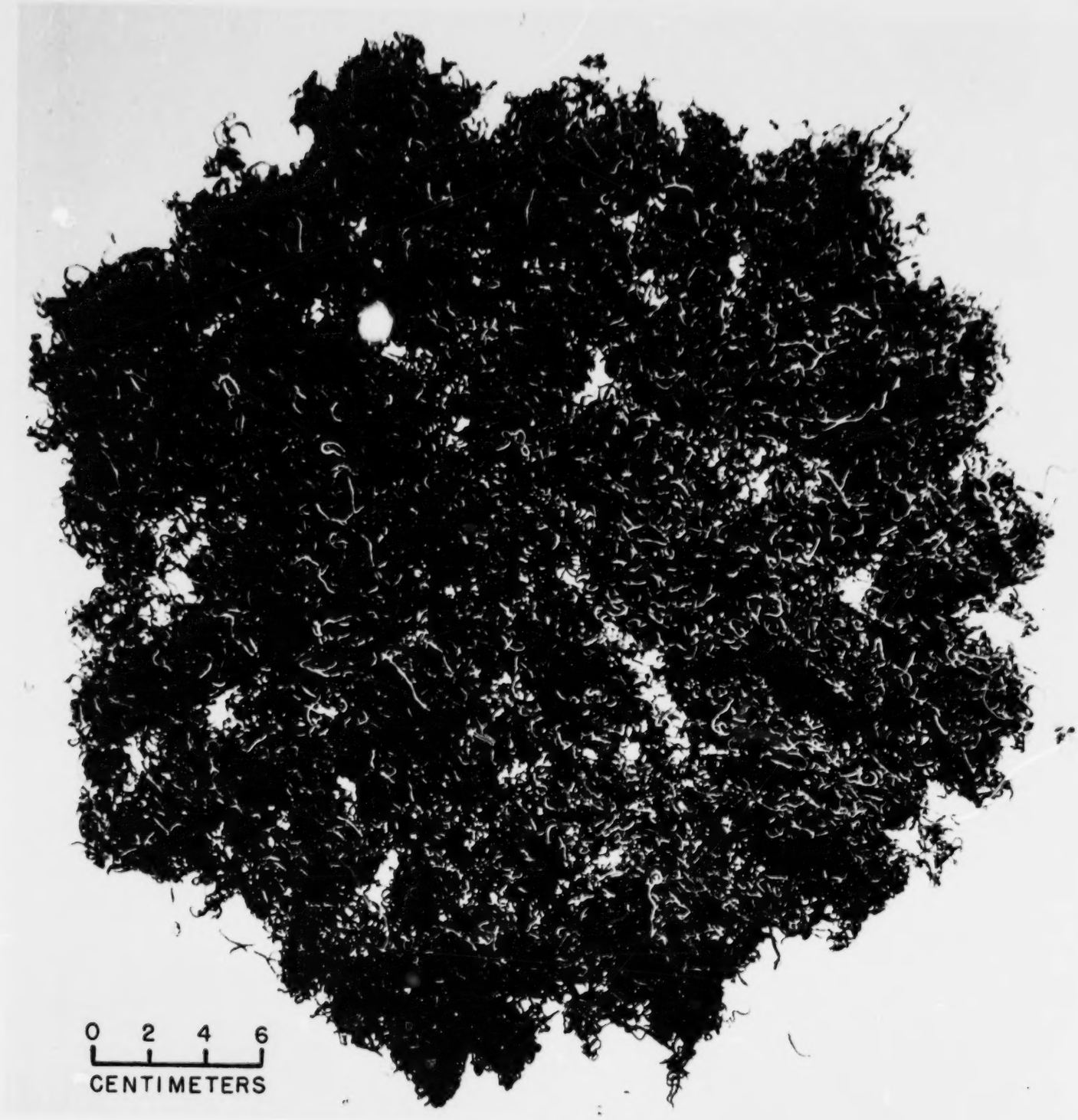

FIGURE 6. A Photograph Showing the Quantity of Sludgeworms, the Only Organism Present, in 1/4 Square Foot of Bottom Surface at Station SS314.0. Compare This to the Organism Diversity and Quantity That Occurs at Station CH326.9 Illustrated in Figure 5.

BOTTOM ORGANISMS

When discussing the response of benthic organisms, other than bacteria, to pollutional environments several aspects must be considered. Some of these are discussed in the body of the text.* It would be wise to briefly review these principles and elaborate on them.

Many times biologists speak of "pollution indicator" benthic macroorganisms. This phraseology is erroneous to the uninitiated. There are no macroorganisms that indicate pollution by their presence. The benthic macroorganisms referred to as "pollution indicators" also exist in the natural environment. The "pollution indicators" have existed long before man began to dump his wastes into any environment. They have not recently evolved to occupy new environmental niches. These organisms are the species that are adjusted physiologically and morphologically to survive environmental conditions that are adverse for most benthic macroinvertebrates. Their less adjusted relatives are driven from the area or killed by the adverse conditions imposed on them.

When only a few varieties survive in an area they reproduce and their young survive in enormous abundance. With the removal of less tolerant forms, competition between kinds is reduced, thus allowing the remaining forms to increase until they compete between themselves. The level at which individual kinds begin to compete among themselves varies from situation to situation. At some point in their growth some factors apparently create so much competition that further increase in the population is not possible. If food, oxygen, and other environmental conditions are not limiting eventually the population stops growth because there is no more space, physically, to put additional organisms. Populations would reach this level in exceedingly rare cases. Usually such things as food, temperature, toxicity, currents, light, and other factors will limit the populations before the area is physically saturated. In many situations it is food availability that controls the level at which competition limits the size of the population.

In areas of heavy organic (food) deposition, the associated physical and chemical factors, drive competitive forms from the area. The quantity of food material being deposited limits the growth of the few remaining forms. Thus, as organics are added competitive forms are driven from the area, and surviving forms increase in numbers due to both the removal of competition and/or increased food supply. If enough organics are added, eventually a "break point" occurs when organic decomposition products create an environment so severe that few, if any organisms, can survive.

Another type of pollutant is the non-organic waste. In this situation various forms are eliminated. The forms surviving increase slightly or not at all. Their maximum number is rapidly reached because nutrition levels do not change. Competition is removed from other forms, but the population increase is soon checked by competition for food between individuals of a form.

As these non-organic wastes increase they will eventually reduce the few surviving forms in number by interfering with reproduction, killing individuals periodically before populations can become well established, destroying the food source, or by making food unavailable. If enough waste is added, eventually conditions become so severe that even the few remaining tolerant forms are eliminated from the environment.

In complex degradation systems of both organic and inorganic wastes the two effects work together. Initially they reduce the number of types. The remaining few types are then

* Refer to "Interim Report Lake Michigan-Illinois River Basins Comprehensive Study," pp. 67-69.

affected by an interaction of the two pollutants. The non-organic may limit the population even though large quantities of organic food are being added. Large quantities of organics may erase the influence of the inorganics by dilution and adsorption. With different types of inorganics entering the environment, it is possible for the effects of one to be reduced by chemical action of another on it; or it is possible for two inorganics to function more severely when together than if kept separate. Thus, in complexes of many types of pollutants being added to an environment there is a constant interplay of influences on the environment at various points.

In discussion of the degradational influences on the macrobenthic fauna of the Chicago Waterways many things must be considered. The ideal situation of one sewage outfall with one type of waste is eliminated. The total number of outfalls may never be tabulated and located,* when one considers the addition and elimination of sewers in a metropolitan area as large and diversified as Chicago. Before one waste effluent is mixed with the water another effluent is dropping into the Waterway. For miles, (in under bridges, from industries, shipping, runoff, etc.), there are waste additions to the system varying in size from small tube drippings to the watershed itself. In addition there is not one type of pollutant, there is a complex, from human excrement to garbage, petroleum wastes, street runoff, heavy metallic ions, tannery wastes, trash dumping, sewage outfalls, etc.; a list of varieties that may never be compiled in a constantly changing metropolitan industrial complex of the magnitude of Chicago.

The simplest way of analyzing the system is to visualize it as a large river system with the headwaters at Lake Michigan consisting of the North Shore Channel below the Wilmette lockage, the Chicago River below the Chicago Harbor lockage, and the Calumet - Sag Canal, all flowing into the Illinois River. This concept does not account for various geographical entities and historical names; but when one considers the man-made alterations, importance, direction and volume of flow, this artificial stream complex is the major drainage pattern of the Greater Chicago Area. In essence there are three major headwater streams in the metropolitan area which eventually, upon junction with the Des Plaines and Kankakee Rivers, form the Illinois River.

A glance at the data indicates one sampling station distinctly different from all the other samples. (Figs. 3 and 4). This is the Kankakee River; the only Station (KR277.5) that exhibits organisms not tolerant of degradation. The quantitative samples exhibit seven major forms of benthic animals, two of which, Caddisflies and Mayflies, tolerate very little environmental degradation. In addition to the quantitative data, two additional forms, Scuds and Damselflies, which are sensitive to degradation are known to exist. Those forms present that will tolerate pollution are relatively low in quantity and do not contribute to an abnormal standing crop dominated by one or a few forms.

The other stations all had one phenomenon in common. There was a general lack of organisms that will tolerate adverse conditions resulting from pollution. Beyond this, the stations varied but little in the kinds of tolerant forms present, but varied tremendously in the quantity of the kinds present. (Figs. 3 and 4).

Beginning at the upstream point, in our general flow pattern, just below the Wilmette lockage there were four kinds present. (Fig. 7). One of these, the Scud, is not typically tolerant of organic pollution. The small numbers of Scuds present make it doubtful if they reproduce in this area; the standing crop may be replenished by individuals carried through the lockage from Lake Michigan. During the period of investigation, April 19 to May 9, 1961, diversion of lake water was obvious. Even with the heavy flows there was evidence of organic sludges which may build up to a considerable extent during periods of nondiversion.

From the Wilmette lockage downstream via the North Shore Channel and the North Branch of the Chicago River a typical organic degradation occurs. (Fig. 7). The reduction in types of kinds, from four at the Wilmette lockage (NS340.7) to one nine miles downstream (NB331.4), and the increase from 1,300 to 47,700 Sludgeworms per square foot at these respective stations is indicative of the organic sludges being deposited in the waterway system.

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* A tabulation of known sources is listed in the "Interim Report Lake Michigan-Illinois River Basins Comprehensive Study," pp. 70-118.

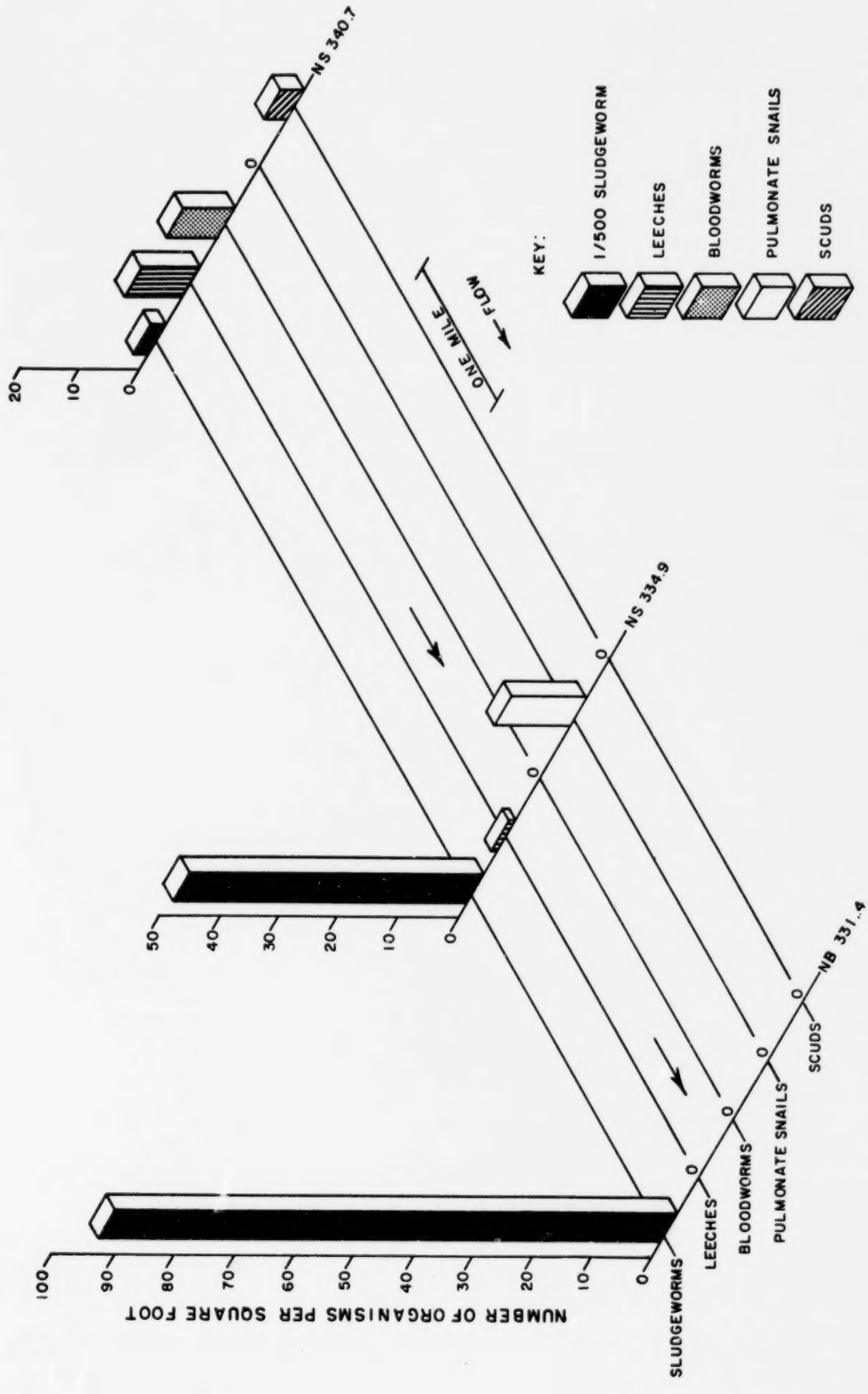

FIGURE 7. Mean Numbers of Benthic Organisms Per Square Foot
North Branch of the Chicago River & North Shore Channel.

Increasing domestic sewage organic loads, entering the canalized waterway, are visible by the increase in organics suspended in the water, as well as the growth of organic sludge deposits on the bottom. Industry does not appear until a short distance before the junction of the North Shore Channel with the Chicago River in downtown Chicago.

From the North Shore Channel the system becomes more complex at the Chicago River junction. As additional tributaries and waste outfalls join the system, inorganics are added along with additional organics, river traffic increases, flow direction varies and velocity changes. With this complexity one major factor remains evident: the degraded water eventually reaches the Illinois River. As degradation products steadily accumulate and flow downstream from Chicago, a variety of organism kinds are eliminated until only one, the Sludgeworm, remains in greater or lesser quantities in the majority of the system. (Figures 3 and 4).

The Chicago River tributary, entering the system with its reversed flow, brings water from Lake Michigan through the Chicago Harbor lockage to the system. The Chicago River, rapidly shows signs of degradation. Even with the "clean" water entering from the lake, only one clean water associate, an Operculate Snail, was found living with degradation tolerant benthic biota. There is a tendency for a reduction in quantity of organisms a short distance downstream, when compared to immediately below the lockage. (Figs. 3 and 4) The reasons for this degradation tendency becomes apparent when stream flow patterns are considered. With a consistent downstream flow, degradation would occur at Stations (CH326.9) and (CH325.8) as a result of additional waste influents as the river proceeds through Chicago. Without diversion the wastes would accumulate because of a lack of dilution water. In addition, periodically the water flows out to Lake Michigan when the Harbor lockages are opened to relieve flood conditions during heavy rainfall in downtown Chicago.* When the flow is reversed, the stream periodically should receive degraded water from the otherwise downstream areas. The associated adverse conditions would then adversely affect populations of organisms that could be sensitive to short-term pollution.

As the stream proceeds, the influence of the addition of cleaner water from the Chicago Harbor is rapidly nullified. At Station (SB324.3), two kinds survive, however, the Sludgeworms are obviously dominant, and the Fingernail Clams are greatly reduced in quantity. (Fig. 3).

Continuing downstream, an area exists (Stations SS320.0 and SS317.3) which appears to be degraded by inorganics. Only the Sludgeworm survives but in greatly reduced numbers. The organic sludges exist in this area, but their food value is apparently "masked out" by inorganics creating conditions so adverse that very few organisms survive or accumulate between periodic destruction of the standing crop.

The addition of the West-southwest Sewage Treatment Plant effluent represents a very significant point downstream. The volume of flow, during the time of collections, being added to the Chicago Sanitary and Ship Canal, may be viewed as a "Tributary" entering the system. Below this point, at Station SS314.0, the quantities of Sludgeworms become very large. (Fig. 6). Some of the organic material settling out creates extensive sludge beds providing food to support a large standing crop of these worms. The inorganic influences noted at stations above this "Effluent Tributary" are apparently diluted by the volume flow or nullified by the large quantities of organics being added.

The next Station downstream (SS307.9) shows a reduction in the numbers of Sludgeworms. This is possibly the result of some reduction of the organics at this station. There is a probability also of some inorganic pollutional influences. Petroleum waste products were discernible in the sludge present here. Below this station another tributary, the Calumet - Sag Canal, enters. Discussion of this tributary will be deferred until completion of the discussion on the "Main Channel," (Chicago Sanitary and Ship Canal).

Below the junction of the Calumet - Sag Canal two distinct types of habitats occur: channelized areas and impounded areas. Channelized areas (Station SS300.5 and below the Lockport Locks SS291.1) are characterized by swift currents that do not allow organic sludge

* Ramey, H. P., "Storm Water Drainage in The Chicago Area," Amer. Soc. Civil Engr., Jour. Hydraul. Div., Paper 1995, Vol. 85, Hydraul. 4, pp. 11-37 (1959).

deposition. Considering the lack of sludge deposition there remains a fair quantity of Sludgeworms that subsist on water suspended organics such as human feces; garbage: as peas, corn, celery, and lettuce, etc.

Impounded areas behind the navigation pools (DP285.8 and IR271.5), the Brandon and Dresden Pools respectively, with their standing water, may be considered as settling basins. The sludge deposits in these impoundments occupy a large portion of the reservoirs. Water depths of only a few feet, outside of the navigation channel, may be found a short distance behind the thirty-eight foot high Brandon Road Dam. In these areas a build-up in the quantity of Sludgeworms occurs. (Fig. 3). Bloodworms and Fingernail Clams were also found in the Dresden Pool.

In the region below the Lockport Locks the Des Plaines River joins the complex. The one station sampled on the Des Plaines immediately above the junction with the Chicago Sanitary and Ship Canal, indicated a lower level of pollution than that which exists in the Sanitary and Ship Canal. Direct comparison with the Chicago Sanitary and Ship Canal Stations is not feasible. The Des Plaines Station (DP292.7) is physically very different from the remainder of the system, being located in shallow water enabling one to see the bottom. It is also devoid of barge traffic.

The Calumet-Sag Canal tributary appears to be the most complex tributary in the system. The Blue Island Locks, immediately downstream from the Little Calumet River, divide this system into two segments. From these locks on the Calumet - Sag Canal to the Chicago Sanitary and Ship Canal, flow is toward the Chicago Sanitary and Ship Canal. This flow is low in both volume and velocity.

In the upper reaches of this section a confirmed canalized area (Station CS317.9) exhibited no organic sludge and few Sludgeworms. This narrow, confined channel exhibits strong vertical currents from barge traffic. These currents apparently do not allow settling of particulate material since no sludge was taken in dredge sampling. It may be assumed that inorganic pollutants and/or benthos disturbance (caused by barge traffic) in this canalized section reduce the expected variety of organisms.

Downstream from the confined canalized area the canal widens. Turbulence reduction allows a settling of organic material (Station CS308.4) and the standing crop of Sludgeworms shows a marked increase, Figure 3.

Above the Blue Island Locks a "settling basin" exists. These Stations (LC322.4 and LC320.1) exhibit heavy sludge deposits. This "settling basin" also extends an undetermined distance up the Little Calumet (Station LC320.2) tributary.

Station (LC322.4) shows the greatest organism diversity in the Calumet-Sag Sytem, Figure 3. Yet this station exhibits a possible influence of partial inorganic pollutants. It is suspected that periodic laminar flows of inorganics into this area may influence the organisms in some "cross-sections" of this stream and not in others.

Above the Blue Island Locks (Station LC320.1) to Lake Michigan (Station CA333), flow is not consistent. Gradient in either direction is negligible. Flow is influenced primarily by the water level in Lake Michigan. Wind influence on lake levels as well as wind originated seiches undoubtedly create intermittent and oscillatory flow direction changes in this "estuary type" situation. Rainfall would also affect flow direction. These influences on the distribution of organisms cannot be ignored. With a "sloshing" action, water degradation agents are semi-confined to a segment of the system. Because of this, water masses may traverse this area in two directions for periods of time, before fractions of the water are discharged in either direction. Dilution is also slow. Thus, the organics from the Calumet Sewage Treatment plant are basically confined to an area above and below the effluent discharges at certain times. The slow progression of water from this area allows organic materials to settle and break down before the water moves out of the area. Sludge movement out of this area is slow.

Another area of "estuary type" is the Calumet Harbor (Stations CA333+ and CA328.1). This area is probably primarily influenced by inorganics from the heavily industrialized environs. Only the Sludgeworm survives in minimal quantities. (Figs. 3 and 4).

A tributary to the system, the Grand Calumet River (Station GC325.8) is unique. This

river has a low flow and a heavy organic load. Sludge deposits are extensive. The sludge decomposition products and associated septicity have influenced this organic environment to proceed beyond the "break point," allowing very few Sludgeworms (40 per square foot of bottom) to survive. Extended periods of septicity prohibit the establishment of quantities of Sludgeworms to utilize the organics present.

PHYSICAL DESCRIPTION OF BIOLOGICAL SAMPLING STATIONS AND THEIR KINDS OF BOTTOM ORGANISMS

Station (NS340.7)

Four types of organisms (i.e., Sludgeworms, Leeches, Bloodworms, and Scuds) were collected. The former three may be classified as pollution tolerant forms; whereas the fourth type, represented by three individuals that were collected, may have been transported from the lake through the lockage.

The bottom material was a heterogeneous mixture of inorganics and organics. This area is canalized at this point, the canalization continuing downstream approximately 2.5 miles below the Northside Sewage Treatment Plant.

Station (NS334.9)

Three types of organisms (Sludgeworms, Leeches, and Pulmonate Snails) were collected. This is the first station below the Northside Sewage Treatment Plant. The stream is canalized. The increase in Sludgeworms is quite evident even though the substrate is not completely covered by sludge. The bottom is largely composed of hard blue clay. The Sludgeworms that were taken were dredged up as solid balls of worms approximately 1-1/2 to 2" in diameter. There was an abundance of suspended solids present such as vegetable fragments.

Station (NB331.4)

Sludgeworms were the only organism found. The channel at this station is much wider than upstream stations and stream velocities were reduced. Sludge deposition is quite evident. The number and volume of Sludgeworms is much increased over the two upstream Stations (NS340.7 and NS334.9). (Fig. 7).

Station (SB324.3)

Two types of organisms (Sludgeworms and Fingernail Clams) were collected. Fiberous sludge was present mixed with silt, sand, and fragments of Fingernail Clam and Snail shells.

Station (SS320.0)

Only Sludgeworms were collected. Petroleum wastes in bottom materials were apparent.

Station (SS317.3)

Only Sludgeworms were collected. The bottom was composed of blue clay, some sand, oil, trash, paper towels, spaghetti, and fresh-appearing vegetable matter.

Station (SS314.0)

Only Sludgeworms were collected. A portion of the bottom was a jelly-like mass of sludge, and some of the substrate was formed from blue clay.

Station (SS307.9)

Sludgeworms were the only organism collected. The bottom was composed of sludge, a few rocks, oil, and grease.

Station (SS300.5)

The bottom consisted of bedrock. Dredge hauls contained fist-size rock fragments covered by the "sewage bacterium," Sphaerotilus. A few Sludgeworms were collected from the rocks and slime. Substrate characteristics prohibited quantitative sampling.

Station (SS291.1)

Sludgeworms were the only form collected. Some organic sludge was present in addition to stones, sticks, and tar balls. Barge traffic apparently prevented sludge deposition.

Station (DP285.8)

Only Sludgeworms were collected. This station was in the Brandon pool. This pool serves as a settling basin in the waterway system. Away from the navigation channel sludge beds exist just two feet below the water surface. Sludges are mixed with grease, oil, and balls of tar.

Station (IR271.5)

Three pollution tolerant forms (Sludgeworms, Bloodworms and Fingernail Clams) were collected. The station, located in Dresden pool, also serves as a settling basin. The substrate is composed of sludge, sand, silt, and plant detritus. Petroleum odors were noticeable in the substrate. Even though this station is below the Kankakee River junction, organism influence from this tributary was not observed.

Station (CA333+)

Only a few Sludgeworms were collected. This was an industrialized area. The bottom was made up of inorganic material with a trace of organic matter.

Station (CA328.1)

A few Sludgeworms were collected. This is an industrialized area. The bottom is composed of blue clay, some gravel, red silt, and oil.

Station (LC322.4)

Four organisms (Sludgeworms, Bloodworms, Fingernail Clams and Leeches) were collected. The bottom was composed of fine loose clay and organic sludge.

Station (LC320.1)

Numerous Sludgeworms and Leeches were collected. This station is between the outfalls of the Calumet Plant. Industrial outfalls were also observed. The bottom was composed of loose clay and silt-like sludge.

Station (CS317.9)

Only Sludgeworms were collected. Barge traffic apparently prevented sludge deposition. Bottom deposits consisted of pea gravel, slate fragments, and fragments of concrete.

Station CS308.4)

Sludgeworms only were collected. This station is below the canalized area of the Blue Island Lockage. Organic sludge deposition was quite evident.

Station (GC325.8)

Only Sludgeworms were collected. The sludge was heavy, partially decomposed, black, and septic. Sludge was observed rising to the surface in chunks. Gas bubbles were numerous and large.

Station (LC320.2)

Two forms of organisms (Sludgeworms and Bloodworms) were collected. Organic silt-like sludge was present. No barge traffic was observed, although pleasure craft did use this area for dockage. The area is basically part of a settling basin for the wastes from the Little Calumet tributary and also for outfall materials from the Calumet Plant.

Station (CH326.9)

Five types of organisms (Sludgeworms, Fingernail Clams, Pulmonate Snails, Operculate Snails, and Leeches) were collected. The bottom was composed of a variety of inorganic and some organic materials.

Station (CH325.8)

Five types of organisms (Sludgeworms, Fingernail Clams, Pulmonate Snails, Operculate Snails, and Leeches) were found. Trash, consisting of newspaper material, cigarette filters, cellophane, etc., was observed in the substrate.

Station (DP292.7)

Four forms of organisms (Sludgeworms, Fingernail Clams, Pulmonate Snails, and Leeches) were collected. This station is not comparable to other stations, since the maximum depth was 18 inches.

Station (KR277.5)

Seven forms of organisms (Sludgeworms, Bloodworms, Fingernail Clams, Operculate Snails, Leeches, Mayflies, Caddisflies) were collected. This was the most diversified population found in the entire system. Some of the forms, such as Mayflies and Caddisflies, are considered to be clean water forms. The bottom is composed of sands, silts and gravels with some natural organic material.

This area is used quite extensively for boating, swimming, sport fishing and water fowl hunting.

PHYTOPLANKTON

Data collected during a six-hour period on both May 10 and May 11, 1961 illustrate the total numbers of phytoplankton per milliliter. (Figs. 8 and 9). These data supplement similar data already reported for April 28 and May 4, 1961.* An additional graph (Fig. 10), plotting the mean of total phytoplankton counts for April 28, May 4, May 10, and May 11, 1961, is presented to summarize the data.

Data indicate that most kinds were found at each of the stations throughout the Illinois Waterway system in Cook County, although numbers of kinds showed considerable variation from station to station.

The data discussed above, based on collections that were made from all stations within a six-hour period, indicate that there is a downward trend in total numbers of algae from the Lake Michigan intakes into the canalized system. Phytoplankton present a transitory picture at any point in a flowing water system in that they are weakly swimming or floating plants without powers of locomotion. Thus, being at the mercy of natural stream velocities, they are not a good index of a fixed station. Too, phytoplankton collections made on different days at the same station may vary widely in numbers per milliliter, since their abundance at any one station might be dependent on the amount of floating solids, turbidity, cloud cover, and varying waste discharges present at different times of collection. For example, these variations are demonstrated through data collected from Stations (SS317.3, SS307.9, CA328.1, and LC322.4) on days between April 25, 1961 and May 11, 1961 as shown in Figure 11. The total phytoplankton counts per milliliter at Station (SS317.3) ranged from a low 1,760 to a high of 3,629. At Station (SS307.9) the range in total count was from 1,378 per milliliter to 2,576 per milliliter, while a variation of 652 per milliliter to 3,119 per milliliter was noted at Station (CA328.1). At Station (LC322.4) the variation was from 254 per milliliter to 2,705 per milliliter.

All phytoplankton counts were made in accordance with the strip count method as outlined in the Eleventh Edition of Standard Methods for the Examination of Water and Wastewater.**

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* See Figs. 11 and 12 in "Interim Report, Great Lakes-Illinois River Basins Comprehensive Study."

** Anon, "Standard Methods for the Examination of Water and Wastewater, Eleventh Edition," Amer. Pub. Health Assoc., New York (1960).

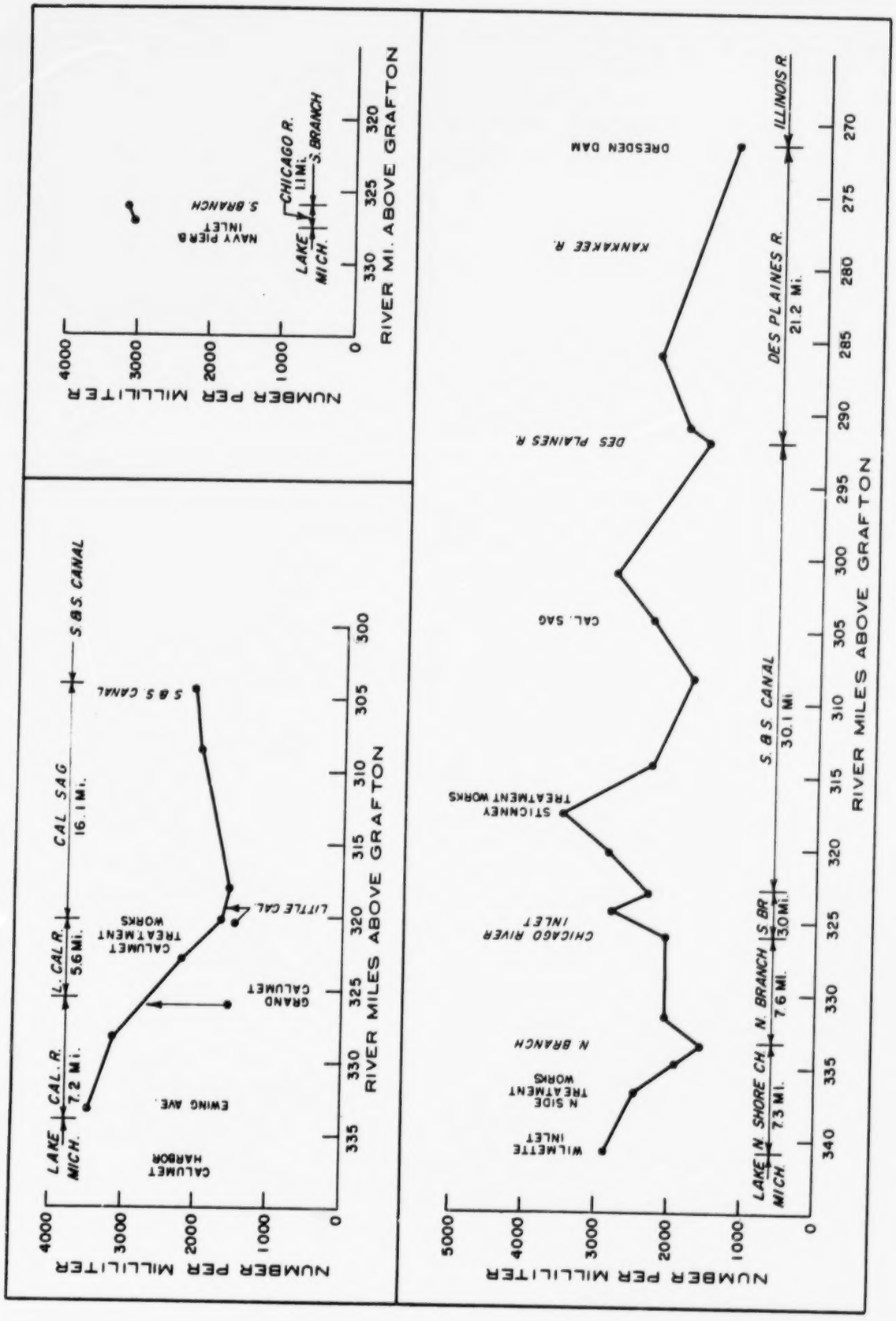

FIGURE 8. Total Phytoplankton Per Milliliter - Illinois Waterway
May 10, 1961.

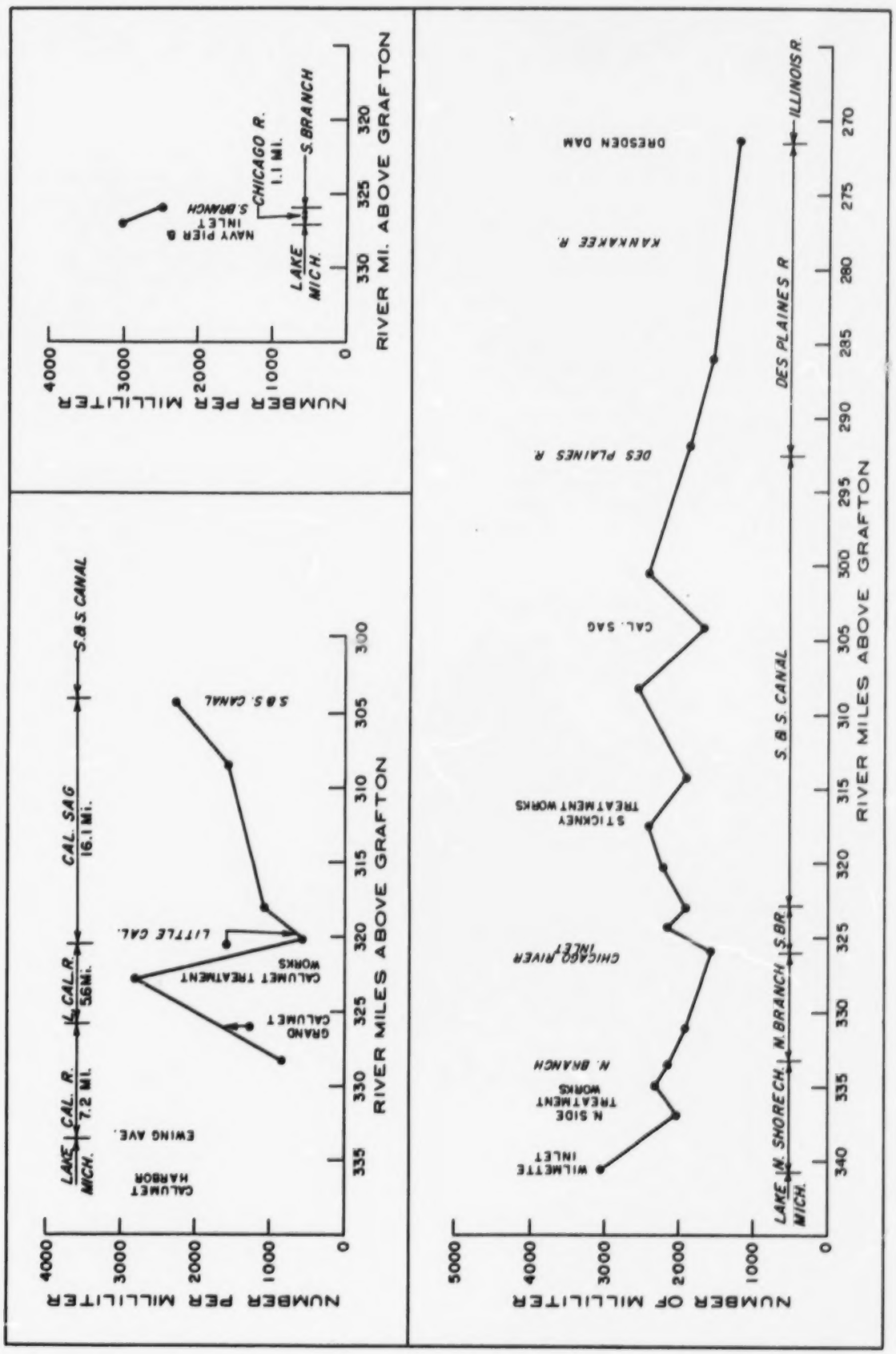

FIGURE 9. Total Phytoplankton Per Milliliter - Illinois Waterway
May 11, 1961.

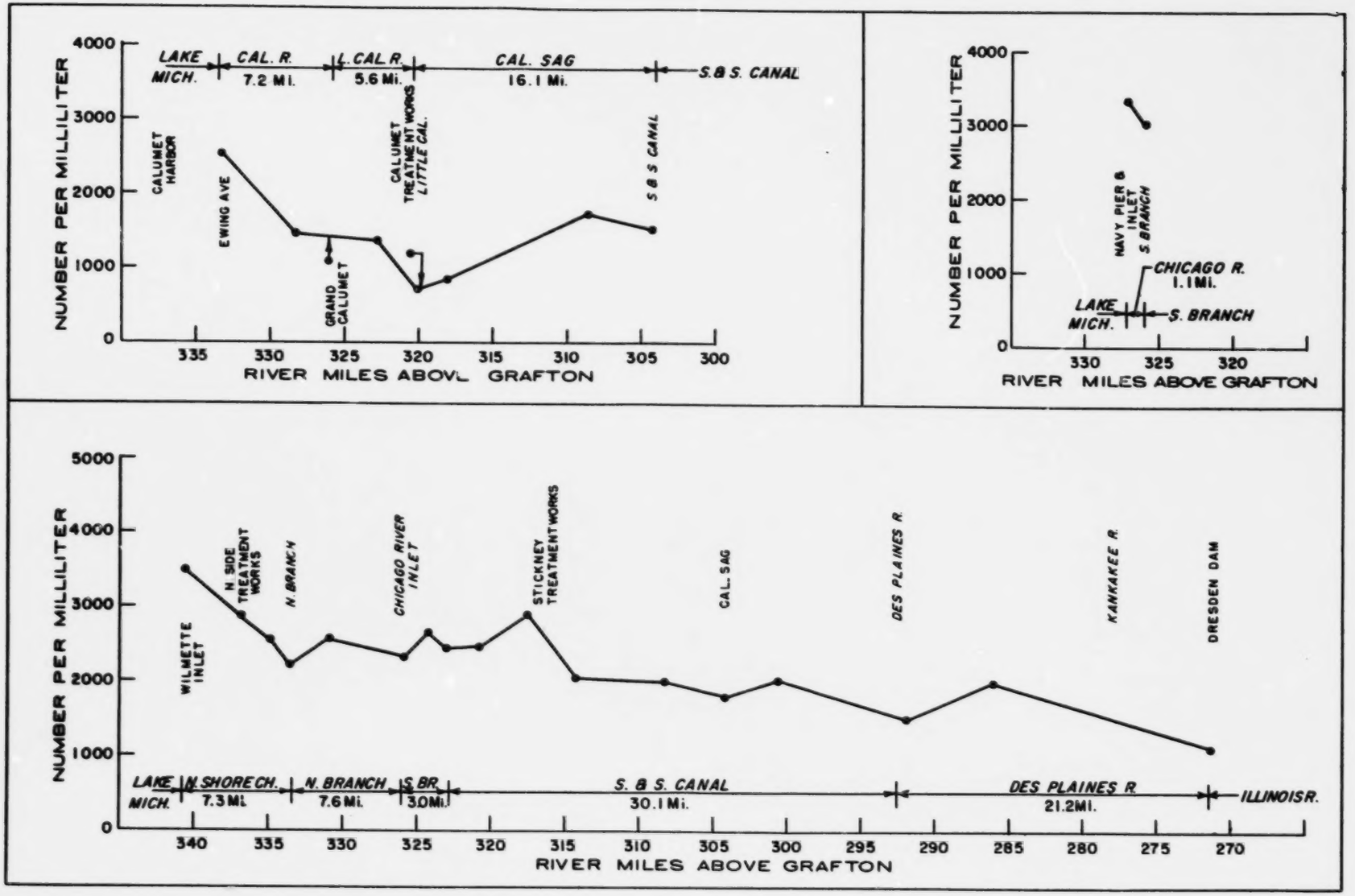

FIGURE 10. Mean Total Phytoplankton Per Milliliter - Illinois Waterway - April-May, 1961.

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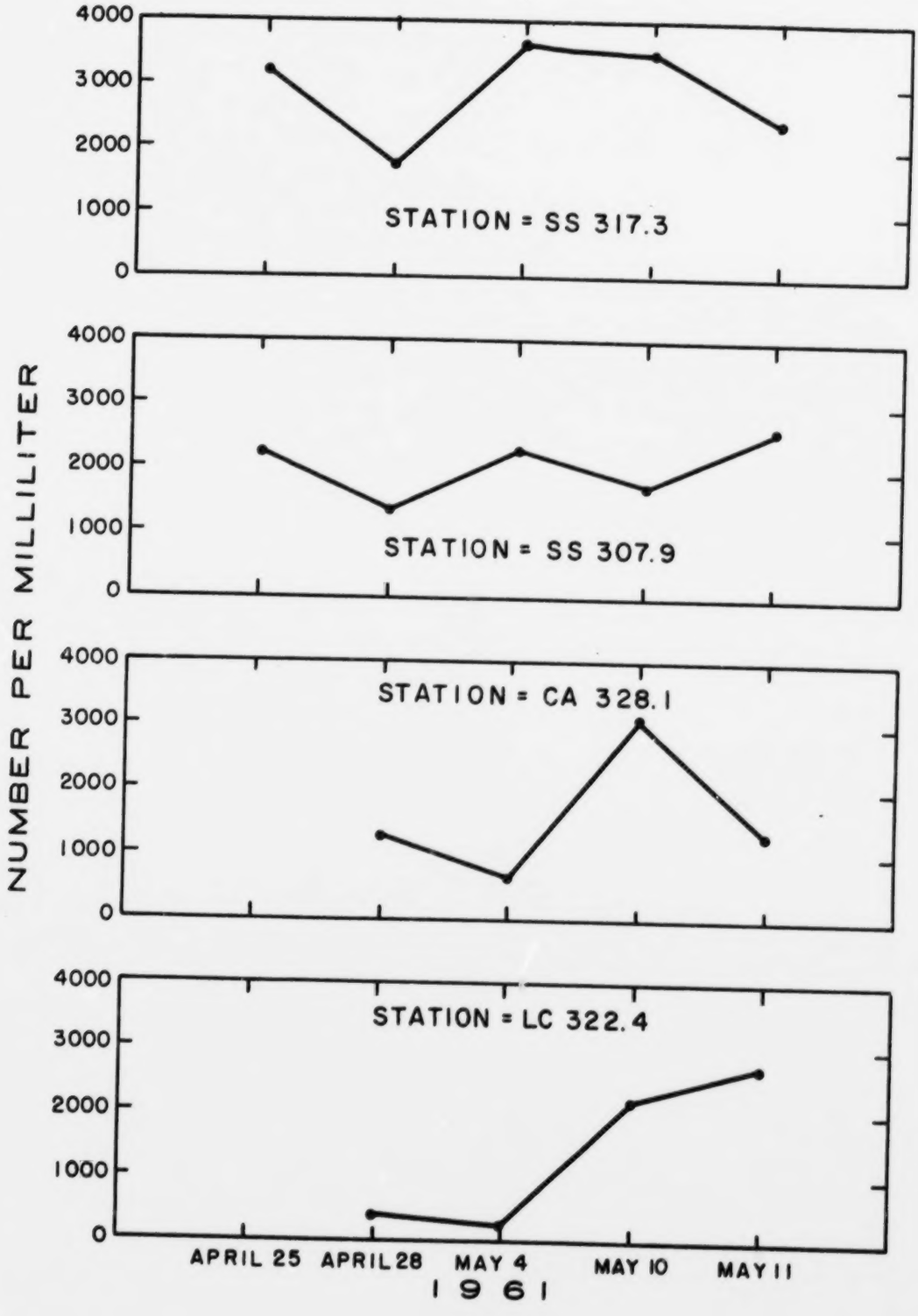

FIGURE 11. Variations at Single Stations in Total Numbers of Phytoplankton Per Milliliter on Different Dates.

GENERAL INFORMATION ON FISH IN THE CHICAGO AREA

During this survey no intensified sampling for fish was undertaken. However, limited collecting, visual observations, and conversations with people in the various reaches of this river system indicate that in some sections of the system certain types of fish are known.

Directly below the Wilmette lockage (NS340.7) on April 21, 1961, Bluntnose and Fathead minnows were collected with a dip net. Further downstream at the junction of the North Branch of the Chicago River and the North Shore Channel, (near Station NS333.4) children were observed fishing. No fish had been caught; questioning revealed that Goldfish and Carp had been taken at this location.

On April 27, 1961 within the Chicago Sanitary and Ship Canal between Stations (SS320.0) and (SS307.9) many recently dead fish were observed, consisting of Alewives, Smelts and Chubs. No live fish were observed at any time in this area during the survey.

Dead Alewives were observed in and below Calumet Harbor (CA333+) on May 9, 1961. Since the flow of water there is so haphazard it is not known if death occurred within the lake or the harbor.

On May 4, 1961 live Goldfish and Carp were observed in the Dresden Pool, (IR271.5) while collecting bottom fauna.

SUMMARY

The analyses of data that were collected during the biological survey indicated that definite degradation by man-contributed pollution had defiled the canalized waterway in the reaches studied; bottom animals especially are expressive of degradation.

The April - May 1961 biological sampling in the Upper Illinois Waterway of the Metropolitan Chicago Area revealed associations of bottom animals indicative of highly degraded water. The bottom animals show responses to both domestic sewage and wastes of industrial origin as degradation agents.

The water quality and bottom conditions determine the type and quantity of organisms present. As long as the water and substrate remain degraded by organics of domestic origin the presence of organisms commonly associated with pollution is desirable. These organic-waste-tolerant bottom animals (notably sludgeworms) are important natural agents in "self-purification." If these organisms are hindered in their activities by materials of industrial origin or by too severe conditions related to domestic sewage pollution the rate of "self-purification" is slowed. A slower rate of "self-purification" in a river results in a downstream extension of the area in which water remains degraded. In essence, biota associated with organic degradants, cannot contribute their share to the natural "self-purification" of a waterway if inhibited by an unfavorable environment.

Phytoplankton aid the "self-purification" process in a stream. Populations of phytoplankton contribute to the oxygenation of a stream through photosynthesis. If phytoplankton populations are hindered in their growth and function, the efficiency of a stream's "self-purification" process may be reduced.

GPO 821-412-2